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PATENT

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Date August 10, 2005

Alexandra Beggs
Alexandra Beggs

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants : Timothy B. Cowles, Brian M.
Shirley and Greg A. Blodgett

Attorney Docket No.: 501030.01

Patent No. : US 6,771,553 B2

Serial No. : 10/056,935

Issue Date : August 3, 2004

Filed : October 18, 2001

Title : LOW POWER AUTO-REFRESH CIRCUIT AND METHOD FOR DYNAMIC
RANDOM ACCESS MEMORIES

REQUEST FOR CERTIFICATE OF CORRECTION

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

**Certificate
AUG 19 2005
of Correction**

Sir:

A Certificate of Correction under 35 U.S.C. § 254 is respectfully requested for the above-identified patent in order to correct Patent and Trademark Office errors made during the printing of the patent. The changes in the patent needed to correct the errors are as follows:

<u>Column, Line</u>	<u>Reads</u>	<u>Should Read</u>
Column 2, Line 49	"spurious command"	--spurious commands--
Column 6, Lines 1-6	"After the input buffers 110 are enabled by a high IBENCLK signal, the IBENCMD signal transitions high to switch the input buffers 110 to a low	--After the input buffers 110 are enabled by a high IBENCLK signal, the IBENCMD signal transitions high to switch the input buffers 110 to a low impedance state and to turn OFF the

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impedance state and to turn OFF the transistors **130-136** so they do not affect the at time T_0 and registered at time T_1 by the rising edge of the external clock CLK signal.”

transistors **130-136** so they do not affect the operation of the power saving circuit **100**. When the input buffers **110** are switched to a high impedance state by a low IBENCLK signal, the transistors **130-136** are turned ON to bias high respective internal command signal lines to which they are coupled.

The internal command signals IRAS*, ICAS*, IWE*, and ICS*, as well as other internal command signals from the input buffers **110**, are applied to a command decoder unit **140**. The command decoder unit **140** generates a plurality of memory commands, including an auto-refresh command AREF, from various combinations of the command signals applied to its inputs. As explained above, the AREF command is asserted responsive to decoding IRAS*, ICAS*, and ICS* active low and IWE* inactive high.

The auto-refresh command AREF is applied to a refresh decoder **150** along with the internal clock ICLK signal and the internal clock enable ICKE signal. Based on the state of the ICKE signal, the refresh decoder **150** determines if the AREF command is for an auto-refresh or if it is for

a self-refresh. If ICKE is high, the AREF command is interpreted as an auto-refresh command, in which case the refresh decoder **150** passes the AREF command to an output terminal as an AREF' command. If ICKE is low, the AREF command is interpreted as a self-refresh command, in which case the refresh decoder **150** generates a SREF command. The refresh decoder **150** command will continue to generate the SREF command until the ICKE signal transitions high.

The AREF command is also applied to a timer **154**, which generates a T_{OUT} pulse after a predetermined period. The T_{OUT} pulse causes the refresh decoder **150** to terminate the AREF' command, thereby terminating the auto-refresh cycle.

All of the input buffers **110**, **120**, **124** as well as the transistors **130-136**, the inverter **138**, the command decoder unit **140**, the refresh decoder **150** and the timer **154**, are shown in FIG. 2 as being located in the command decoder **4**. However, as previously mentioned, these components could alternatively be located elsewhere in the SDRAM **2** or in other memory devices.

The operation of the power saving circuit **100** will now be explained with reference to the timing diagram of FIG. 3. The combination of control signals ("CMD") that constitute an auto-refresh AREF command are applied to the SDRAM **2** at time T_0 and registered at time T_1 by the rising edge of the external clock CLK signal.--

Column 7, Lines 14-66

"The operation of the power saving circuit **200** is substantially the same as the power saving circuit **100**. Specifically, in response to registering an AREF command, the IBENCMD, IBENADD and IBENCLK signals transition low to disable the input buffers **102**, **110** and the internal clock buffer **230**. As a result, neither the input buffers **102**, **110** nor circuitry (not shown) downstream from the internal clock buffer **230** consume power during the auto-refresh cycle initiated in response to the operation of the power saving circuit **100**. When the input buffers **110** are switched to a high impedance state by a low IBENCLK signal, the transistors **130-136** are turned

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AREF command is interpreted as an auto-refresh command, in which case the refresh decoder **150** passes the AREF command to an output terminal as an AREF' command. If ICKE is low, the AREF command is interpreted as a self-refresh command, in which case the refresh decoder **150** generates a SREF command. The refresh decoder **150** command will continue to generate the SREF command until the ICKE signal transitions high.

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The operation of the power saving circuit 100 will now be explained with reference to the timing diagram of FIG. 3. The combination of control signals ("CMD") that constitute an auto-refresh AREF command are applied to the SDRAM 2 AREF command."

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Column 18, Line 21	"coupled thorough"	--coupled through--
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The Commissioner is hereby authorized to charge payment of any fees associated with this communication to Deposit Account No. 50-1266. A duplicate copy of this sheet is enclosed.

Favorable consideration of this Request is respectfully requested.

Respectfully submitted,

Date:

August 8, 2005

By:

Edward W. Bulchis

Edward W. Bulchis, Reg. No. 26,847
Customer No. 27,076
Dorsey & Whitney LLP
1420 Fifth Avenue, Suite 3400
Seattle, WA 98101
(206) 903-8785
Attorney for Applicant(s)

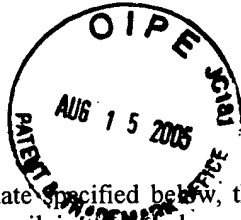
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Seattle, WA 98101
(206) 903-8785
Attorney for Applicant(s)

EWB:tdp

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UNITED STATES PATENT AND TRADEMARK OFFICE
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PATENT NO. : US 6,771,553 B2
DATED : August 3, 2004
INVENTOR(S) : Timothy B. Cowles, Brian M. Shirley and Greg A. Blodgett

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Column 2, Line 49	"spurious command"	--spurious commands--
Column 6, Lines 1-6	"After the input buffers 110 are enabled by a high IBENCLK signal, the IBENCMD signal transitions high to switch the input buffers 110 to a low impedance state and to turn OFF the transistors 130-136 so they do not affect the at time T_0 and registered at time T_1 by the rising edge of the external clock CLK signal."	--After the input buffers 110 are enabled by a high IBENCLK signal, the IBENCMD signal transitions high to switch the input buffers 110 to a low impedance state and to turn OFF the transistors 130-136 so they do not affect the operation of the power saving circuit 100 . When the input buffers 110 are switched to a high impedance state by a low IBENCLK signal, the transistors 130-136 are turned ON to bias high respective internal command signal lines to which they are coupled.

The internal command signals IRAS*, ICAS*, IWE*, and ICS*, as well as other internal command signals from the input buffers **110**, are applied to a command decoder unit **140**. The command decoder unit **140** generates a plurality

of memory commands, including an auto-refresh command AREF, from various combinations of the command signals applied to its inputs. As explained above, the AREF command is asserted responsive to decoding IRAS*, ICAS*, and ICS* active low and IWE* inactive high.

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command will continue to generate the SREF command until the ICKE signal transitions high.

The AREF command is also applied to a timer **154**, which generates a T_{OUT} pulse after a predetermined period. The T_{OUT} pulse causes the refresh decoder **150** to terminate the AREF' command, thereby terminating the auto-refresh cycle.

All of the input buffers **110, 120, 124** as well as the transistors **130-136**, the inverter **138**, the command decoder unit **140**, the refresh decoder **150** and the timer **154**, are shown in FIG. 2 as being located in the command decoder **4**. However, as previously mentioned, these components could alternatively be located elsewhere in the SDRAM **2** or in other memory devices.

The operation of the power saving circuit **100** will now be explained with reference to the timing diagram of FIG. 3. The combination of control signals ("CMD") that constitute an auto-refresh AREF command

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“The operation of the power saving circuit **200** is substantially the same as the power saving circuit **100**. Specifically, in response to registering an AREF command, the IBENCMD, IBENADD and IBENCLK signals transition low to disable the input buffers **102, 110** and the internal clock buffer **230**. As a result, neither the input buffers **102, 110** nor circuitry (not shown) downstream from the internal clock buffer **230** consume power during the auto-refresh cycle initiated in response to the operation of the power saving circuit **100**. When the input buffers **110** are switched to a high impedance state by a low IBENCLK signal, the transistors **130-136** are turned ON to bias high respective internal command signal lines to which they are coupled.

The internal command signals IRAS*, ICAS*, IWE*, and ICS*, as well

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MAILING ADDRESS OF SENDER:

DORSEY & WHITNEY LLP
1420 Fifth Avenue, Suite 3400
Seattle, Washington 98101

Patent No. US 6,771,553 B2

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are applied to the SDRAM **2** at time T_0 and registered at time T_1 by the rising edge of the external clock CLK signal.--

--The operation of the power saving circuit **200** is substantially the same as the power saving circuit **100**. Specifically, in response to registering an AREF command, the IBENCMD, IBENADD and IBENCLK signals transition low to disable the input buffers **102, 110** and the internal clock buffer **230**. As a result, neither the input buffers **102, 110** nor circuitry (not shown) downstream from the internal clock buffer **230** consume power during the auto-refresh cycle initiated in response to the AREF command.--

as other internal command signals from the input buffers **110**, are applied to a command decoder unit **140**. The command decoder unit **140** generates a plurality of memory commands, including an auto-refresh command AREF, from various combinations of the command signals applied to its inputs. As explained above, the AREF command is asserted responsive to decoding IRAS*, ICAS*, and ICS* active low and IWE* inactive high.

The auto-refresh command AREF is applied to a refresh decoder **150** along with the internal clock ICLK signal and the internal clock enable ICKE signal. Based on the state of the ICKE signal, the refresh decoder **150** determines if the AREF command is for an auto-refresh or if it is for a self-refresh. If ICKE is high, the AREF command is interpreted as an auto-refresh command, in which case the refresh decoder **150** passes the AREF command to an output terminal as an AREF' command. If

ICKE is low, the AREF command is interpreted as a self-refresh command, in which case the refresh decoder **150** generates a SREF command. The refresh decoder **150** command will continue to generate the SREF command until the ICKE signal transitions high.

The AREF command is also applied to a timer **154**, which generates a T_{OUT} pulse after a predetermined period. The T_{OUT} pulse causes the refresh decoder **150** to terminate the AREF' command, thereby terminating the auto-refresh cycle.

All of the input buffers **110, 120, 124** as well as the transistors **130-136**, the inverter **138** the command decoder unit **140**, the refresh decoder **150** and the timer **154**, are shown in FIG. 2 as being located in the command decoder **4**. However, as previously mentioned, these components could alternatively be located elsewhere in the SDRAM **2** or in other memory devices.

The operation of the power saving circuit **100**

will now be explained
with reference to the
timing diagram of FIG. 3.
The combination of
control signals ("CMD")
that constitute an auto-
refresh AREF command
are applied to the
SDRAM 2 AREF
command."

Column 8, Line 41	"("0" for full AREF period)"	--"0" (for full AREF period)--
Column 8, Line 54	"when the AREF command"	--when the AREF command is asserted--
Column 8, Lines 56 and 62	"to end of the"	--to end the--
Column 10, Line 23	"operable to removing"	--operable to remove--
Column 11, Line 54	"and a detecting"	--and detecting a--
Column 12, Line 37	"transition terminate"	--transition to terminate--
Column 13, Lines 3 and 5	"and decoder"	--and decode--
Column 13, Line 17	"coupled thorough"	--coupled through--
Column 14, Line 64	"coupled thorough"	--coupled through--
Column 16, Lines 43 and 46	"decoder"	--decode--
Column 16, Line 59	"and coupled thorough"	--and coupled through--
Column 17, Line 8	"to removing"	--to remove--
Column 18, Lines 3 and 6	"decoder"	--decode--
Column 18, Line 21	"coupled thorough"	--coupled through--
Column 19, Line 22	"claim 63"	--claim 62--
Column 22, Line 4	"claim 89"	--claim 88--

MAILING ADDRESS OF SENDER:

DORSEY & WHITNEY LLP
1420 Fifth Avenue, Suite 3400
Seattle, Washington 98101

FORM PTO-1050 (REV. 3-82)

501030.01 PTO 1050

Patent No. US 6,771,553 B2

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AUG 22 2005